

THE THERMOMETER
IN
VETERINARY MEDICINE

GEORGE ARMATAGE

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THIRD EDITION
REVISED AND ENLARGED

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VETERINARY MEDICINE

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AS AN
AID TO DIAGNOSIS

IN
VETERINARY MEDICINE

BY
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PREFACE TO THE THIRD EDITION.

IN a careful perusal, many years ago, of the observations of Davy, recorded in his 'Researches: Physiological and Anatomical,' on the temperature of man and animals, the following conclusions were established in the mind of the writer :

The record of facts in connection with the phenomena of animal life, originating in the operation of fixed and complex laws which govern the economy of nature, must ever be regarded as of the utmost importance. Our present state of knowledge is entirely dependent upon ascertained truths, and the opening up of new channels of information is impossible without them.

That as the range of animal temperature in health, as measured by the thermometer, is confined within certain limits; also that, as accurately recorded by Davy, it is clearly established, there is a possibility of wide departure from those limits in subjects dying from various diseases, the study of Animal Temperature in Relation to Disease becomes one of paramount importance to the Veterinarian.

In the reliable testimony afforded by Davy was recognised the invulnerable foundation upon which the whole subject of Animal Temperature in Relation to Disease was resting; while it presented a vast area, hitherto almost unexplored, capable of yielding inestimable truths in connection with the maladies of the speechless servants of mankind.

The absence of literature bearing directly upon the subject did not present itself as an insuperable barrier, as might be expected. Nature appeared in the attitude of invitation—beseeching mankind to hear the story from her own lips. The prosecution of inquiry also promised a yield of abundant results, involving no inconvenience, nor the least suffering, to any living creature.

Following repeated outbreaks of disease, in 1865, came the Cattle Plague, contemporaneous with Epizootic Pleuro-Pneumonia; and, shortly after, Epizootic Aphtha among cattle, and Typhoid Fever appeared among pigs. In 1870, Influenza prevailed among horses in the Metropolis, some hundreds of which were under the immediate care of the writer. Abundant scope was thus given for observation amongst many thousands of animals, distributed over the southern, eastern, and midland counties of England, as well as in the west of Scotland. Stimulated by the excellent example of Davy, facts were recorded, and in the following pages are given the conclusions derived therefrom.

The subject was at first dealt with, in a somewhat in-

complete form, in a paper presented to the North of England Veterinary Medical Association in 1869, and published by request. Since that time the subject has awakened greater interest among veterinarians, resulting in a greater demand for information ; and the inquiry is not limited to the profession. As the subjects of a conservative management and sound preventive measures are comprehended, the clinical thermometer will prove an essential necessity in the hands of the stockowner and breeder. A careful perusal of these pages will reveal the methods by which the instrument may be understood to declare its utterances, whether as by prophecy the approach of contagious disease, the progress of present disease destruction, or the probable cause of sudden death ; an especial advantage in those instances where post-mortem examinations are neither safe nor wise.

Previous editions being exhausted, the present is issued, after careful revision and considerable augmentation, with the view of meeting, to some extent at least, the inquiries in respect of this all-important subject.

GEORGE ARMATAGE.

6th Month, 1894.

INTRODUCTION.

To reach even the present state of our acquaintance with the use and value of the thermometer in veterinary medicine, much abstruse and controversial matter has been studied. The question, from the outset, faithfully demonstrates how the progress of ideas may be traced to an ultimate application of the most valuable practical utility.

Much as the schools of ancient medicine have differed from each other in their teaching and argument, we, at the present day, have cause for congratulation in the mass of information that has been handed down to us. Whatever may be the differences, in the result or the inferences drawn from their line of investigation, it is palpably evident that at the present our knowledge without them would assume a peculiarly different aspect.

Utopian or apparently valueless as may appear the assumption of Galen and the Greek school of physiologists, who ascribed the origin of animal heat to the heart alone; that of the chemists who followed, and declared it to be the result of a fermentation within the

blood; or the intro-mechanicians who advocated the theory that heat was generated by means of friction established between the blood and sides of the vessels; the opposite conclusions of Mayhow; the experiments of Lavoisier; theory of specific and latent heat of gases as advanced by Dr. Black, and their subsequent application by Crawford; the experiments of Priestly, of Brodie, Majendie, Bernard, Le Gallois, Despretz, Callenfells, and many others; all have a direct bearing upon the subject before us. They have served to dispel error by courting inquiry and research; to place truth in its most powerful and convincing light, and secure a realization of results of the highest possible value.

The great school of difficulty through which most of the fundamental matter has been derived will be found described in Bostock's 'Physiology,' third edition. Much valuable information on the temperature of man, birds, and animals, with the influences exerted by tropical climates, exercise, etc., is given in Dr. Davy's 'Researches: Physiological and Anatomical,' the 'Philosophical Transactions of the Royal Society'; Dunglison's 'Human Physiology'; Carpenter's 'Principles of Human Physiology,' sixth edition; with Thompson's 'Animal Chemistry,' and other works British and foreign, to which these writers refer, also abound with rich intelligence.

Among those who have studied the use of the thermometer in relation to disease in the human subject are Gierse, Roger, Valentin, Von Bærensprung, Wunderlich,

Friedlander, Virchow, Fraube, Jockmann, Greisinger, Billroth, and others, in Germany, Saxony, etc.; Becquerel, Breschet, and Bernard, in France; Parkes, Jenner, Ringer, Aitken, Dowler, Dunglison, Edwards, and Horne, in Britain. And on its use among the lower animals in Britain we have a dissertation by Professor Gamgee in his work on the 'Cattle Plague'; a reference by Dr. Sanderson in his report on the Cattle Plague to the Royal Commissioners, 1866; and an article by Mr. George Fleming, of the Royal Engineers, published in the 'Veterinarian,' for 1866, page 76. These, being the most accessible to Veterinarians, are particularly valuable.

Regarding the nature of the thermometer as an instrument in general use for meteorological observation, its selection, liability to variation and inaccuracy from defective manufacture, and notices of the most eminent makers—among whom Casella stands one of the foremost—much useful information may be gleaned from Buchan's 'Handy Book of Meteorology' (Blackwood and Sons), and profitably applied to the instrument now under consideration.

THE THERMOMETER

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DESCRIPTION OF THE INSTRUMENT.

BEFORE proceeding to the subject which immediately concerns us, it is necessary to point out the character of the instrument made use of for the purpose of pathological observation.

I believe we are indebted to Mr. L. Casella, philosophical instrument maker to the Admiralty, of 147, Holborn, London, for the perfection to which the clinical thermometer has been raised. Many years ago the attention of Dr. Aitken was directed to the subject of morbid temperature in man, and after remarking the errors and inaccuracies which attended the use of instruments of the ordinary kind, Mr. Casella, I think, suggested its construction on the index or self-registering principle, commonly known as Phillip's.

Thermometers not so constructed are unsuited for clinical purposes. They are not capable of indicating correct maximum temperature; therefore—and doubtless with other errors attaching to low-priced instru-

ments—afford results from which nothing positive can be drawn. A slight movement on the part of the animal, relaxation of the sphincter, discharge of flatus, a gust of wind, with endless other conditions, are apt to influence the non-registering thermometer, and reduce the observations to inutility.

The instrument in general use is composed of a glass tube or stem and elongated bulb; the former being drawn with the utmost regularity and mathematical precision, which admits of no unevenness in the size or movement of the column of mercury, upwards or downwards. It is also graduated from 80° to 115° Fahr., each degree being divided into fifths or tenths if required.

In order to preserve an instrument at once so fragile and delicate in positions and movements calculated to inflict serious damage, it is placed in a german-silver tube or shield, the lower, or bulb, end being removable. The object of the latter is to admit of the clearing away of faecal matters, which accumulate in the orifices cut in the sides of the tube and around the bulb, and to adapt the instrument to the rectum of smaller animals (Fig. 1).

The specific nature of the thermometer, however, remains to be described. This consists of a loose or separate portion of the column of mercury in the stem, which constitutes the index or register. In the process of filling of the tube, a globule of air is allowed to enter, and this suffices to keep the main column and upper portion apart. When the instrument is handed to the purchaser, he will find the index at the upper or tail end of the stem perfectly stationary, and about three-fourths of an inch in length; while no proportion of the ordinary column is visible above the part cut out of the tube to expose it, and the vernier or scale, during observation.

This description applies to the 10-inch instrument of Casella. Shorter, and more convenient, as well as self-registering thermometers, are now constructed, viz.,

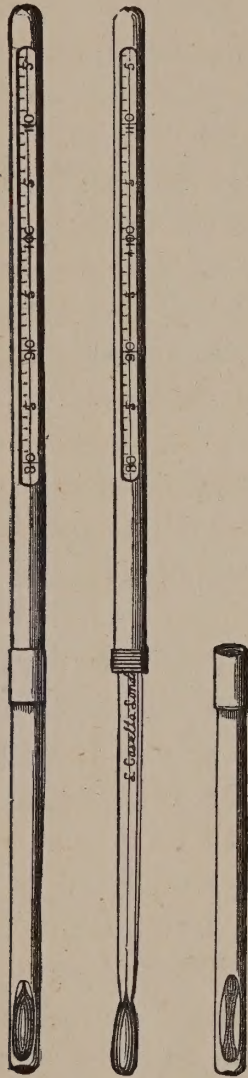


FIG. 1.

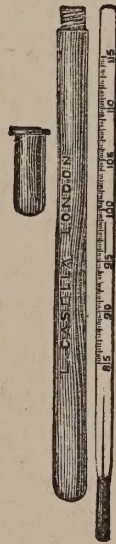


FIG. 2.

7-inch and 5-inch, having no outside metallic tube. These are suitable for the horse and cattle, and equally so for the smallest patient of the veterinary surgeon.

The maker further ministers to the safety of the thermometer by placing it in a suitable wooden tubular case. In order to prevent the index descending to the bulb during carriage, the stem is placed downwards, and the whole is then conveniently accommodated in the breast-coat pocket, by stitching up one side, so as to make a pouch the size of the outer case (Fig 2).

Before the thermometer can be used the index must be set, which is accomplished in the following manner. The stem of the instrument is to be held firmly in the hand, the bulb end free, when, standing clear of all objects, the arm is raised, outstretched, and brought swiftly down past the side. This act—on the principle of centrifugal force—is to be repeated until the index is set below 85° or 90° Fahr.; but the operator must guard against forcing the index too far beyond the exposed part, as it may reach the bulb, when the instrument becomes *non-registering*.

The rectum of domestic animals is chosen in preference to the vagina, which often registers a lower temperature; less inconvenience also arises, and the instrument is inserted to the extent of three inches at the bulb end, and allowed to remain from three to five minutes. The heat of the body expanding the mercury in the bulb, drives a portion through the stem, and when it reaches the index, carries it forward. The temperature being fully communicated, the index ceases to move, and when the instrument is withdrawn the column will be seen to recede, leaving the index to point out the maximum temperature, which is done by the extreme end, or that farthest from the bulb.

EARLY USE OF THE THERMOMETER AS A TEST OF MORBID TEMPERATURE.

ALTHOUGH we are assured that the thermometer was employed by the veterinarians of the Continent as far back as the middle of the last century, and later by the medical men of Britain and the European and American continents, the earliest notice of it in England among veterinarians occurred only in 1865. As is well known, the Cattle Plague was first introduced into London, and the first case appeared on the 19th of June in that year. Professor Gamgee was at that time preparing to open the Albert Veterinary College. I had the good fortune to unite with him in the work at that period, and then saw the thermometer first made use of as a means of investigation in diseases of the lower animals. Dr. A. Gamgee, in Edinburgh, to whom the results were communicated, also subsequently made use of it in experiments with inoculated calves, and from that time it has been acknowledged that the instrument has serviceable properties as an aid to the investigation of contagious diseases in the lower animals.

These facts are given with emphasis, as others arrogate to themselves the credit of having *discovered* (?) *the use* of the thermometer. I, therefore, unhesitatingly state that the *discovery* of the thermometer, as a test of morbid

temperature, was prior to 1865—in fact, according to Paulet, as quoted by Fleming,* as far back as the middle of the last century; and the first in Britain to *use* it as such was Professor Gamgee, to whom all others become subordinate.

* *Vet.*, 1866, p. 76.

ANIMAL HEAT, OR TEMPERATURE, AND ITS VARIATIONS IN HEALTH.

I HAVE already alluded to the pioneers in this department of physiology, and it becomes necessary to refer but briefly to the phenomena of animal temperature in health and its variations.

Avoiding the speculative theories and controversial dogmas that preceded the present age, we strike sharply upon the principles generally accepted at this day, as afforded by a comprehensive view of the question.

The experiments of Sir Benjamin Brodie,* although acknowledged to be somewhat imperfectly executed, followed by those of Le Gallois and Despretz,† served to demonstrate the influence of the nervous system in the generation and maintenance of animal heat. Chossat, Earle, and Dunglison supported these views by showing that paralysed limbs exhibited a depression of temperature within them, and Waller, with Claude Bernard, added to these laurels by pointing out the relaxation of the arteries after division of the sympathetic trunk, which contributes to form the vaso-motor nerves.

Despretz decided by his elaborate experiments that the heat evolved was in direct ratio to the amount of oxygen consumed, and stamped the truth of Dr. Davy's

* 'Philosophical Transactions,' 1812, p. 378.

† Ann. de Chim. et de Phys., xxvi., 337-342.

researches,* which demonstrate that in birds, in which the respiratory process is extremely rapid, animal temperature is the highest, amounting to 107° and even 111° Fahr. Also among volant insects a higher degree exists than in terrestrial varieties, although among the latter it preponderates in favour of those having the largest respiratory apparatus—the range being from 76° to 81° Fahr. In amphibia, the respiration being almost imperceptible or absent, their temperature is scarcely perceptible above the medium in which they exist. In the class mammalia, sheep appear to sustain the highest temperature. In the month of January, 1838, when the external temperature stood at 29° Fahr., that of three sheep indicated 104° in the rectum, while some of the internal organs were as high as 107° Fahr.

My own observations on the temperature of healthy ewes and lambs have led to the following results, which, it will be apparent, corroborate the foregoing. When the thermometer on one occasion stood at 52° Fahr. in the shade (wind W.N.W., with little sun, cold, chilly, and generally dull), the adult sheep registered a mean temperature of $104^{\circ}\cdot2$, and the lambs $104^{\circ}\cdot1$ Fahr. The lowest reading given by the ewes was $103^{\circ}\cdot2$ and the highest $105^{\circ}\cdot2$ Fahr. The lowest among lambs was $103^{\circ}\cdot2$ and the highest 105° Fahr. Of the lowest readings in both ewes and lambs I am somewhat in doubt, as from the negligence of an assistant the observations were interfered with. The animals were in pasture, the lambs being about one month old.

These results are at variance with those obtained by Dr. Sanderson, who records the average daily temperature

* 'Researches, Physiological and Anatomical,' vol. i., p. 104.

at $103^{\circ}2$ Fahr. in a ewe, and $102^{\circ}7$ Fahr. in a ram.* The discrepancy I think may be readily accounted for by the fact that, in the experiments of Davy and myself, the animals were at large, possessed of a thick fleece, which, being a bad conductor of heat, retards the cooling influence of the atmosphere on the skin, and allows a steady transpiration to proceed; besides, in cold weather, and particularly during dryness of the atmosphere, the respiratory process is active, aëration of the blood more complete, and the digestive function vigorous. With the subject of Dr. Sanderson's observations matters were different. They occupied a stable, in which the air was not so cool as the external atmosphere, and, in addition, was of a moist character from the presence and respiration of other animals; they took no exercise, and were chiefly fed on corn, hay, and turnips. Under such conditions the functions would not proceed in the vigorous manner consonant with nature; therefore, in pursuing our investigations upon animals, in reference to their temperature in relation to disease, variations must be acknowledged as arising from the conditions in which they are found. Animals subjected to confinement, and a warm moist atmosphere, will not exhibit such an amount of functional activity as those enjoying their liberty, and, as a rule, do not afford such high readings of the thermometer.

The following observations go far to establish the truth of the foregoing statements:

I. A mare, five years old, doing regular light work, amounting only to exercise, exhibited a temperature of

* Third report of Royal Commissioners to the Privy Council 1866, pp. 18 and 51.

99° 4-5ths in the morning, which seldom varied more than one or two fifths during the remainder of the day.

II. A brown cob, eight years old, during a series of observations, gave the mean result of 99° 1-5th Fahr. The lowest reading, 99° Fahr., occurred when the stable was warm and atmosphere moist; the highest, 99° 6-10ths Fahr., when the air was cold and dry. This animal took no exercise for a week except what he could obtain in his box. He was perfectly healthy, and received three half-quoterns of oats per diem, with hay.

III. An aged white horse in perfect health exhibited a temperature of 99° 2-5ths, when at rest, in a very imperfect farm stable; but when turned into a pasture, and his corn withdrawn, after a few days the temperature rose to 100° Fahr. The weather was cold, the atmosphere being 50° Fahr.

IV. An aged bitch gave the mean reading, during a lengthened period of observation, of 100° 3-20ths. The lowest register was 98° 8-10ths, which was nearly uniform when several days were occupied in confinement; but when she was allowed to run at large through the day, the temperature, after a few hours' rest at the close, was 101° Fahr.

V. A dog ten months old, son of the above, continually at large, gave a reading of 101° 5-10ths on several occasions.

VI. The bitch (No. IV.) after registering 98° 8-10ths, was immediately fed plentifully on scraps of meat, etc.; at the end of three-quarters of an hour the temperature rose to 99° 9-10ths. After this walking exercise over two miles of road was given, the temperature rising to 102° Fahr.

From Davy we also learn that in man the standard

temperature, in a temperate climate, may be estimated at 98° Fahr., while a variation of one-half to three degrees higher must be allowed for a hot climate and atmospheric deviations. The order in which he places animals in accordance with their temperature is : birds highest ; mammalia next ; fishes, amphibia and certain insects third ; and lowest of all, mollusca, crustacea, and worms.*

Probably the most interesting variation of temperature in animals slaughtered during health, given by the foregoing writer,† is that in connection with venous and arterial blood. In the first set of experiments five lambs were taken—the atmospheric temperature registering 65° Fahr. in the shade. The mean of these were : venous blood 101°·6, arterial 104°·8 Fahr. Simple non-registering thermometers were used, the bulb being placed in the carotid artery and jugular vein, respectively.

Dr. Davy next investigated the temperature of the blood in the ventricles of the heart, and in four animals, lambs, killed for the purpose, the following results were obtained : the mean temperature was, rectum, 104°·2 ; left ventricle, 106°·6 ; right ventricle, 105°·7 Fahr. The highest temperature was, right ventricle, 106° ; left ditto, 107° ; rectum, 105° Fahr. Similar elevations of temperature also marked the internal organs, the liver registering 106°, while that of the brain amounted only to 104° Fahr.

From these facts, admitting them to be correct, although there is reason to fear, by the means employed, that the figures are really below than above the mark, we gather

* *Op. cit.*, pp. 196-7.

† *Ibid.*, p. 142, *et seq.*

important lessons. First, that in the elevation of the temperature of arterial blood we recognise the source of animal heat, as derived from the large amount of oxygen it contains, and meeting with products of the assimilative process, oxidizable material, in its passage through glands and other organs actively employed in the preparation of the component parts of the body ; second, that parts removed from the centre of the body, particularly the extremities, indicate a lower temperature ; third, and as also corroborated by experiment, increase of respiration, and circulation, as in exercise, by accelerating the combusive process, a corresponding increase of temperature, generally about one degree, is obtained. Wine, and alcoholic drinks produce a depression of temperature ; while, after a moderate meal, without alcohol, an increase takes place.

In young animals I have observed the temperature is usually a few fifths, or about one degree higher than in older ones. This relates to those that are active. Old and decrepit animals exhibit a depressed temperature. The *diurnal* variation is usually to the extent of two or three fifths, and in some cases one degree, the lowest temperature being in the morning and the highest at night. This is doubtless referable to the season of repair, when the system is subject to greater activity from food, and the comparative cessation of waste and decay of tissue which ensues from the labour of the day.

Ordinary purgation effected by aloes or salines, and diuresis by the latter, or exposure to low temperatures, although producing the sensation of coldness, do not affect the temperature beyond two or three fifths, or one degree in extreme cases.

AVERAGE OR STANDARD TEMPERATURE IN HEALTH.

THE object of a series of observations on the temperature of our domestic animals, is the determination of an average result, or, in other words, the mean of a number of readings, which may be accepted as a standard of healthy condition, and lead to a proper estimate of the variations which succeed to external influences, but exist totally apart from diseased action.

Notwithstanding the many observations that have been made, I may venture to state that sufficient attention has not been paid to external influences. My own impression is their inaccuracy lies in this neglect, for judging from discrepancies that exist in frequent observations recorded of animals housed, and others of the same species at large, the mean of all would not admit of the results that have been arrived at. Berger, quoted by Thompson,* gives the following as the 'Mean Heat of Quadrupeds':

Monkeys	...	...	...	99°·7.
Carnivorous Quadrupeds	...	...	...	103°·264.
Gnawers (Rodentia)	...	..	...	101°·939.
Pachydermata...	...	...	...	105°·231.
Ruminantia	...	...	...	104°·029.
Solipedes	...	...	...	99°·644.
Amphibia and Cetacea	...	...	...	101°·5.

* 'Animal Chemistry,' p. 629.

These are collected from all sources, and apply to wild, as well as tamed, creatures. In each of these, excepting the horse and monkeys, the natural functions of life are carried on with vigour and regularity, and a high uniform standard is the result. But with the horse, pre-eminently the servant of man, circumstances operate which are entirely absent in any other case; we must, therefore, be prepared to accept a wider range of temperature than is here recorded by the observer.

Seeing, as we have already explained, the several effects of exercise, food, and confinement on the system, we are constrained to inquire what will be the standard temperature of the various animals, and beyond which we may judge of the existence and intensity of disease. As the subject is presented to myself, it appears absolutely necessary that we should carefully take into consideration the mode of life to which each of our patients is subjected, and particularly the treatment received during the hours immediately preceding a visit and inspection. We must acknowledge a range of temperature in the horse during health from 98° to 102° Fahr., and this is supposed to apply more or less to the dog. Professor Gamgee* says the normal temperature of cattle is from 100° to 101° , but it may rise to 102° Fahr. Such a range as indicated in the horse and other animals I am inclined to attribute, from observation, to the periods of absolute rest and effects of exercise. This is a matter of importance, and requires our greatest vigilance, otherwise, if such an extensive range is accepted without qualification, we must view many high readings as immaterial, or unprophetical, and meaningless, when in reality the utmost alarm is predicated; and a rapid descent within that

* 'The Cattle Plague,' p. 40.

range, which by experience we are taught is at all times portentous, would also be regarded as a matter of little or no moment.

The effects of confinement upon animals are well exemplified in the cases of the sheep experimented upon by Dr. Sanderson, and from these, as also the results of my own observations, I am inclined to pay special attention to the condition under which the animals are found. By such a proceeding we may adopt a greater certainty as to the range of healthy temperature. Unless this is clearly established, the thermometer will prove of little service in a great many instances, that of the ewe and ram already named being a forcible example. Assuming the healthy temperature of the sheep, without special considerations, is from 104° to 105° Fahr., what are we to infer from the fact that the ewe and ram, in the Cattle Plague experiments, only registered 102° and 103° Fahr.? In accordance with experience it would be reasonable to suppose they were suffering from typhoid disease; but they were healthy. When they were inoculated the temperature rose to $105^{\circ}4$ —but a trifle over the ordinary range in health. Here, then, we obtain an evidence of a diseased condition, existing under a supposed normal aspect, as afforded by temperature; but if we examine more closely the influences which surround our patients, together with the true physiology of the subject, we shall be able to account for much that appears now ambiguous and desultory. The elevation of temperature after inoculation, although within the range ascribed to health, might be taken as proving nothing, not being even the evidence of disease, yet in reality it is a most significant token in animal physiology. When we acknowledge the service of the thermometer in veterinary practice, and

study its warnings, we shall also recognise the collateral influences of a meteorological character, which play such an important part in the production and cure of disease, and have as yet attracted so little attention from us. Thermometry and meteorology are, by no means, the least among the many branches which make up the great science of veterinary medicine.

It is therefore evident, as already shown by Davy and others, that the amount of animal heat in healthy animals is considerably altered by various collateral circumstances. The point of distinction between the variations of temperature in health and those which are the result of disease is, that the former are temporary, confined to narrow limits, rarely more than the fraction of a degree in man; while those consequent upon diseased action are persistent, marked by a wider range, and continuous with the duration of the malady. In the lower animals, which form the patients of the veterinarian, the variation may extend to one degree.

In order, therefore, to avoid erroneous conclusions, it is necessary to bear in mind the various collateral agencies which, during health, exercise an influence upon animal temperature. 1. *Active exercise*, when not continued so as to produce exhaustion or fatigue, increases animal heat in direct proportion to the exertion made by the animal. 2. *Exposure to cold with inactivity* causes a decline of temperature; but, as will be observed in Case III., when allowed to graze in the pasture, an elevation of three-fifths of a degree was evident. 3. *After a full meal* the temperature at first declines, but rises as digestion proceeds. 4. *The temperature of the atmosphere influences the temperature of the body*, sudden transitions from cold to heat giving rise to feverish

states, as indicated by increased heat, accelerated pulse, and respiration, especially when exertion is enforced.

5. In tropical countries the average temperature of the body may be regarded as about 1° Fahr. higher than in cooler regions. 6. Of the three most important functions, circulation, respiration, and animal temperature, the last is most readily affected: more sensible of outward impressions. This is especially the case in disease. The state of the animal temperature, therefore, is an unerring indication of the presence or absence of disturbance; and, further, it also declares to us the intensity, the devastation, so to speak, which is the result of that disturbance.

A knowledge of thermometry in the treatment of disease in the lower animals is of the utmost importance, and, we would almost conclude, of even greater value in veterinary pathology than in human, as such patients, being denied the power of speech, are unable to afford information on the nature or extent of their sufferings.

The following table exhibits the mean, and range of temperature, as observed by me in the various animals from time to time. It is not supposed to be free from inaccuracy, but yet may be found serviceable, and particularly as it is corrected by more numerous and erudite observations.

It should be stated that Casella's self-registering clinical thermometer, Fahrenheit scale, was used throughout the investigations recorded in this treatise. A variety of instruments are in the market, scarcely any two by the same maker being reliable in measuring the temperature of the same animal. By experience we have concluded that Casella's thermometers, although at first costly, are most trustworthy, because every precaution is taken during manufacture to ensure their uniform accuracy.

ANIMALS.	AVERAGE DURING CONFINEMENT.	RANGE IN CONFINEMENT.	AVERAGE IN WORK, ETC., OR AT LIBERTY.	RANGE DURING WORK, OR AT LIBERTY.
Sheep	102 5-10ths	102 to 103*	104 5-10ths	104 to 105
Lambs	Undetermined	Undetermined	104 9-10ths	104 2-5ths to 105 2-5ths
Pigs	101 6-10ths	101 to 102 2-5ths	103 2-5ths	103 to 104
Oxen and Cows ...	100 4-5ths	100 2-5ths to 101 3-5ths	101 4-5ths	101 to 102
Calves and Sturks	100 9-10ths	100 1-10th to 100 6-10ths	101 9-10ths	101 5-10ths to 102 5-10ths
Dogs	99 10-30ths	98 8-10ths to 99 9-10ths	101 2-10ths	100 2-10ths to 102 5-10ths
Horses	99 2-10ths	99 to 99 6-10ths	100 3-5ths	100 to 101

* Dr. Sanderson in his report to Commissioners, 1866, pp. 18-51.

VARIATIONS OF ANIMAL TEMPERATURE, THE RESULT OF DISEASE.—MORBID TEMPERATURE.

WE now arrive at that part of our subject which treats of the disturbance of temperature in morbid states of the body, and set out with the proposition that, as a standard temperature in health is the result of certain vital, physiological and chemical processes, deviation, in disease, must be in direct proportion to the progress and intensity of disease, or resulting destruction of tissue, as well as the nature of organs implicated. Such deviation will be found to vary considerably, and the thermometer becomes the means by which not only general and special centres of disease may be indicated, but also the infallible test of approaching contagious disease, its gradual progress in intensity, or the more welcome approach of convalescence.

The thermometer is pre-eminently an aid to diagnosis. It reveals with clear and distinct minuteness those changes which we fail to interpret by any other means. It strengthens the hands of the observant practitioner from stage to stage, and, unerringly, though silently, as with finger on the lip, records for his information the processes of the invisible war between life and death. It is the province of the veterinarian to understand the language in which the thermometer speaks. This is not

of difficult attainment where the powers of observation are trained by a persevering desire to aid the suffering and speechless servants of man.

We have already seen, although incidentally, that in health a standard or average temperature is consistent with a normal state of the circulation. We have now to notice, conversely, that an abnormal elevation of temperature is invariably attended with a proportionate acceleration of the circulation, as indicated by the pulse. The general signs of the disease also bear a close relation. It is possible, however, that an absence or incompleteness of congruity in this respect may exist; yet whatever may be the disproportion between the phenomena of circulation, abnormal temperature, and pyrexia, the only safe conclusions are to be derived from accurate measurement of the temperature by the thermometer. Under ordinary circumstances the co-relation of the pulse and respiration will be found somewhat as follows: For every degree registered above 98° Fahr., an increase of about ten pulsations will usually be observed. This may be stated in further detail:

Temperature of 98° Fahr. corresponds with a pulse of 40			
„	99°	„	50
„	100°	„	60
„	101°	„	70
„	102°	„	80
„	103°	„	90
„	104°	„	100
„	105°	„	110
„	106°	„	120

In horses it will be found that the destruction of tissue is so great under high temperature that, when the ther-

mometer registers 105° to 107° Fahr., the pulse has become almost, if not entirely, imperceptible, and coma is more or less established from blood impurities. Among sheep and lambs the normal temperature is often as high as 104° and 105° Fahr. We may, therefore, expect to find corresponding elevations in acute diseases, such as 112° and even 114° Fahr. In dogs also, as already pointed out, the normal temperature is higher than that of horses and cattle. Such a variety of creatures forming the patients of the veterinarian, each presenting special features with regard to animal temperature, demonstrates the necessity for accurate observation, if successful results are aimed at.

It is well to observe also that fluctuations may often arise which are perfectly consistent with health. As long as they are confined within the limits already pointed out, viz., from 98° to 102° Fahr., we may be assured that nothing beyond purely local and unimportant disturbances exists. What we must be prepared to understand is that all acute diseases, however slight, not only occasion a higher registration of heat, but exhibit the tendency to rise, the thermometer accurately measuring the intensity of the diseased forces at work within. This abnormal temperature is always the indication of the existence of febrile action; its absence is as surely indicated by normal heat and placid condition of all the functions.

The observant practitioner, who has proved the value of the thermometer in the investigation of disease, will readily recall many cases in which the unaided observation failed to warn him of either the existence of disease or dangers. Modern observers, Wunderlich at the head, adduce numerous illustrations of this; and from

1839 this important truth has been left on record by Davy.*

* Among the many 'brilliant' experiments of modern physiologists, attended with prolonged suffering and ultimate sacrifice of animal life, few are worthy of the distinction, or entitled to the same rank of importance, as this simple discovery of Davy. Almost by accident, yet while he was in the path of simple painstaking observation, he seized upon a grand truth, and, although at the time he was unable to estimate it at its real worth, he had the courage to record it. The discovery of the circulation was not even more valuable. We can hardly estimate its important bearing upon the study and treatment of disease.

Dr. John Davy had been informed that the temperature of insane persons was 'below the average temperature of man.' He was led to question the accuracy of the results of previous observers, and he says, 'this feeling induced me to institute some trials, for the purpose of arriving at some certainty on a point not without interest and importance, both theoretically, and in regard to the management of the insane.' The whole subject is of such scientific value and interest, that we quote the author's words *in extenso*. After giving a tabular statement of his observations, he goes on to remark :

'From these observations it would appear that the temperature of the insane, as of persons not so afflicted, varies slightly in different individuals ; that it is not lower in the insane, but rather higher ; and that it varies slightly in summer and winter, being greatest in summer—in accordance with the preceding observations, made on occasions of rapid transition from one climate to another.

'The tolerance of cold and of heat by the insane, is a question totally different from the foregoing on their internal temperature. That they bear in most instances degrees of heat and cold, without complaining, which to sane persons would be disagreeable, is a well-established fact, however it may be accounted for. Probably neither heat nor cold affects their senses in the same degree as it does those in perfect health. Agreeably to this view, it may be remarked that certain organic lesions occur in the insane, unaccompanied by the ordinary symptoms : thus, tubercles not only form in their lungs, but also tubercular excavations, often unattended with cough, or difficulty of breathing, as if the parts had lost their sensibility. But notwithstanding no warning is given of the mischief in progress, it runs its course, terminating in death as certainly

Many striking instances may be cited in which the existence of disease is indicated by the thermometer before it can be detected by any other means. This especially applies to

CONTAGIOUS AFFECTIONS.

Bovine Diseases.—The value of thermometrical observations in Cattle Plague has already been alluded to in

and rapidly as if indicated by the common train of symptoms. The analogy may hold good as regards heat or cold in their influences on the constitution of the insane ; whether felt or not, excess or deficiency of temperature may be as injurious to them as to individuals possessed of the most delicate sense of them.

‘Incidentally, I would remark that in this class of maladies, in which the ordinary symptoms of associated disease are so often latent, attention to the temperature, as well as to the pulse, may be of great use to the medical attendant. The pulse and the temperature may make him acquainted with the existence of disease before not suspected, and may lead to inquiry of a minute kind, by which the exact species of the adventitious disease may be discovered. The case of C. T. Lewis, one of the patients in the lunatic asylum, whose temperature was ascertained and given in the preceding table, is a striking example of the use of such observations. On the 4th of August [1838] the temperature under the tongue was found to be 104°·5 Fahr., and his pulse rapid. This called attention to his state ; and, although he made no complaint—his appetite good, the functions, as far as was known, tolerably well performed—it was inferred he had obscure disease of the lungs. He died in less than a month, namely, on the 26th of August. The fatal disease was pulmonary consumption, organically considered, in an aggravated form ; but in relation to symptoms most mild. There were ulcers of larynx without affection of voice ; most extensive disease of lungs, vomicæ and tubercles without cough ; ulceration of intestines without diarrhœa ; and disease of testes, vesiculæ seminales, and prostate, of a severe kind, equally latent, excepting in the testicle, the hardness and enlargement of which, but without pain, were casually noticed.’

—‘*Researches, Physiological and Anatomical,*’ vol. i., p. 203.

reference to the practice of Professor Gamgee, and its subsequent application by Dr. Sanderson when engaged to furnish his report to Government on the results of experiments conducted in the Albert Veterinary College in 1865-6. During its prevalence in the Metropolis and South of England, I had frequent opportunities of testing the value of the thermometer in that disease; but in addition to its power of showing the *intensity* of febrile action, as is already known, its readings during observation in apparently healthy animals have been the means of safely pronouncing the *approach* of cattle plague.

The period of incubation in this disease has been defined to be from four to seven days, and is rarely delayed beyond the eighth day. It is now generally acknowledged that animals, in which the usual symptoms are not visible within ten days after being exposed to the contagion, may be regarded as perfectly free. Inoculated animals exhibit the symptoms about the sixth day, being in all cases preceded by an elevation of temperature, noticeable on or about the fourth day. In all those instances where the use of the thermometer fails to record an elevation of temperature during such period of incubation, the only conclusion is that the observations have not been conducted with needful care.

With *Epizoötic pleuro-pneumonia*, and *Epizoötic aphtha*, a similar augmentation of temperature may always be detected during their incubative stages. In 1865 I found an elevation of temperature in cattle inoculated for pleuro-pneumonia before signs were developed, and in those which died from that mode of inducing disease.*

* Details in connection with these investigations cannot now be supplied. Unfortunately my notes—with many relating to other scientific matters—were destroyed by water used in extin-

The elevation of temperature in animals undergoing the incubative stage of contagious disease appears, on a careful inquiry, to be consistent with general laws. All practitioners have noticed that cattle after infection with the virus of Epizoötic Pleuro-Pneumonia exhibit for a time a marked disposition to improve in condition, but at length suddenly fall off, and within a few hours the symptomatology of the malady is developed. The cause which gives rise to this enables us to explain the rise of temperature. Any animal being infected and undergoing the period of incubation, possesses within the organism the virus or germ of the disease. The first portion affected is the blood—as an inevitable result—and containing an eminently foreign ingredient, specific effects, exerted upon the nervous centres, are rendered evident in the form of a stimulus to the assimilative functions. Increase of the combustive process also takes place, and the result is an elevation of temperature within; and this is secured more effectively by the immediate condition of the skin, which, receiving an augmented influx of blood in common with other organs, becomes somewhat defective in its refrigerating powers. In other words, it is like a dry membrane; it admits of the passage of few materials from the body, and the cooling influences are retarded thereby.

The variable period of incubation in the three diseases will, of course, produce corresponding differences in the time at which the preceding elevation of temperature is expected to take place. In the statements given by Dr. Sanderson a rise of one, two, and even three degrees occurred, after inoculation for Cattle Plague, within

guishing a fire which occurred on the premises where my goods were stored at the time.

periods varying from thirty-six hours to the third morning; while the symptoms were delayed two or three days later. It is also remarkable that the delay was productive of a higher temperature— 2° or 3° —and in those cases where it appeared early, it did not amount to more than one degree.

In animals infected with Pleuro-Pneumonia an elevation of one or two degrees has been noticed about a week prior to symptoms appearing, but within four days it has been even higher. The temperature varied from $103^{\circ}2$ to 104° , and in disease it rose to 107° Fahr.

In Epizoötic Aphtha, probably not more than twenty-four hours elapse between the elevation of temperature and appearance of the symptoms.

The value of thermometrical observations in epizoötic affections is established by the following occurrence. Being on a visit, a few years ago, to a friend largely engaged in agriculture, the conversation was directed to the value of the thermometer, especially during the incubative stages of contagious diseases. The subject was new to my friend, and, being anxious for information, an adjournment to the cowhouse took place. Six animals were tested, and in all an elevation of temperature was indicated, the thermometer recording from 103° to 104° Fahr. I inquired if any new animals had been brought in, and to all my questions relative to the possibility of contagious disease having been brought to the stock, I received assurances that such an event could barely be possible. Knowing that Epizoötic Aphtha prevailed some few miles away, I informed my friend what my conjectures were, but he was disinclined to share in my alarm. Every cow was in splendid condition, all the healthy functions of life being apparently fulfilled. On

the most scrutinizing investigation being made, not a trace of the coming disease could be seen, yet I maintained my firm belief that the cows were then in the incubative stage of Epizootic Aphtha, adding that my friend, the thermometer, had never yet failed me, and the morrow, I felt convinced, would decide the question. True it was, for next day vesicles appeared in the mouth and upon the teats, and some of the cows suffered somewhat severely.

As an aid to diagnosis in the contagious diseases of bovine animals, I view the thermometer as invaluable; and as such I have called the attention of the Highland and Agricultural Society of Scotland to it, in my prize essay on Pleuro-Pneumonia,* as the means by which its approach may be anticipated, and the hands of a machinery considerably strengthened in its conservative operations upon the stock of the United Kingdom.

Equine Diseases.—In this department my observations have been confined to spontaneous glanders. In all cases an elevation of temperature accompanied the presence of symptoms; and in two others—one treated by a practitioner for a bruise in a fore leg, the other exhibiting only dulness and anorexia—an elevation of temperature preceded, by two or three days, glandular enlargement and ulceration of the Schneiderian membrane. I had also the good fortune to witness several cases of glanders which immediately followed unwarranted antiphlogistic treatment. Signs of simple catarrh arose in a stud of eighty horses, the majority of which were affected, but only three or four were put under treatment—those of the mildest character and occupying the best stables.

* 'Transactions of the Highland Society of Scotland,' vol. iii., p. 67, 1870.

These animals were subjected to repeated doses of nitre, acetate of ammonia, and other depressing agents, and glanders appeared in each of the cases. An elevation of temperature took place in all, and after proving the existence of other diagnostic signs they were destroyed. The readings were from 103° to 104° Fahr.

Ovine Animals.—I have not had an opportunity of testing the thermometer in small-pox among sheep, but have no reason to believe any difference is present in what appears to be a general law in the incubative stage. The temperature in sheep being higher in health than other animals, a corresponding increase—generally amounting to 105° or 107° Fahr.—may be expected.

ENZOÖTIC DISEASES.

In this section reference is made to that class of diseases which, assuming virulent states, occasion serious mortality among cattle and sheep. These are several forms of anthrax or carbuncular diseases, commonly known as ‘quarter ill,’ ‘splenic apoplexy,’ ‘braxy,’ etc.

The usual visitations of these maladies in former years have been characterized by peculiar local habitats; thus one pasture on a farm or estate, etc., was the specific plague spot; in others the entire district or tract of low-lying land was the infected area. During later years we have suffered from an alarming extension of the complaints. Land previously innocent and harmless, but fertilized with shoddy manure, has induced serious and often fatal disease in horses, cattle, and sheep grazing upon it. Splenic apoplexy, hitherto principally confined to few districts, has also found its way to the feeding stalls of the best regulated farms by means of imported feeding

stuffs, carrying off the most valuable and promising animal after an illness of a few minutes' duration. Sometimes the dead carcase found in the early morning is the first evidence of the obscure causes.

In all these instances the thermometer is invaluable as a means of diagnosis, or defining the disease during life, the intensity of which is declared by the elevation of temperature, which is attained within a few hours, or even less, viz., 104° Fahr. in bovine animals, and often 107° Fahr. in sheep. The decline takes place in one of the following ways, viz., sudden, when the blood, charged with impurities, fails to afford nourishment to the nervous centres, as indicated by insensibility; and a fall of the temperature to 94° Fahr., or less in the ox tribe, and 97° Fahr. or 98° Fahr. in the sheep.

It may be said, perhaps, that the thermometer proves more signally valuable in attacks of splenic apoplexy, not only in defining the disease, but for declaring the cause of death when the carcase is discovered as the first intimation of the malady.

In defining the disease the elevation of temperature, viz., 104° Fahr. in cattle and 107° Fahr. in sheep, is reached within a few hours or less. The rapid development of signs, as sudden insensibility and falling to the ground, the escape of bloody froth, etc., from the mouth and nostrils, is sufficiently obvious, but the elevation of temperature, as shown by the thermometer, confirms the decision. Suppose, however, that the animal is not discovered during the seizure, but is found dead after an acute attack of the kind we have described—say within a few hours, then also the thermometer, which cannot fail, registers the abnormal temperature. This in itself removes many other affections from the list of probable

causes, as they are not productive of such high readings in the short period of attack common to the disease in question. The usual tendency is for such high elevations of temperature to remain some time, rising even after death, instances of which are given at page 62. Similar results also attend other forms of acute blood-poisoning, inflammations, etc., as long as the brain is not interfered with, and form reliable means of diagnosis in numerous instances.

The value of this method of observation is further evident in splenic apoplexy, and some other states in which a post-mortem examination is neither prudent nor safe. The most deadly results have been communicated to mankind when the blood falls on the skin, a raw or abraded surface not being essential to secure fatal blood-poisoning.

NERVOUS AFFECTIONS.

A horse affected with *ramollissement*—softening—of the olfactory bulbs exhibited a register of $103^{\circ}\cdot 2$ for weeks at work; two hours before death it was $105^{\circ}\cdot 3$ Fahr.

In *tetanus* sufficient opportunities have not been offered, since I commenced to take observations in morbid temperature, to enable me to speak with great precision. In each the symptoms were recent, but the animals being owned by fidgety proprietors, no opportunity was given for treatment, and consequently, also, none of moment for observation. The temperature varied in all from 100° to 102° Fahr., and in one only could I succeed in using the thermometer a second time. It then showed an increase of only about half a degree in twelve hours. This, however, might have been caused by the treatment, which, projected endermically, diminished the spasms, and, by

virtue of their action in restraining nervous energy, the medicines would prevent a great or rapid rise in temperature.

Schroeder Van Der Kolk* states that a thermometer placed on the forehead and vertex of an epileptic patient in convulsions gave a reading of 13° Fahr. above the temperature of the cheek.

In a dog, recently, under the physiological effects of strychnine for paraplegia, the temperature rose to 103° Fahr. With the decline of nervous twitchings and sensibility, animal heat gave way, death taking place shortly after, the thermometer registering 95° Fahr.

Rabies Canina, or Hydrophobia.—I am indebted to my friend and late colleague, Professor Duguid, for the following readings in connection with hydrophobia in dogs, calves, and sheep.

A Scotch terrier, placed under my care for observation when at the Albert Veterinary College, London, had been bitten by a rabid dog on the 23rd of February, 1866. He had exhibited signs of perfect health up to the 14th of March, when symptoms of dumb rabies appeared. The state of the pulse could not be determined, owing to the violent paroxysms into which the animal was thrown on being touched, but Mr. Duguid succeeded in registering the temperature, which was 104°·8 Fahr. These symptoms continued till the 16th, when the pulse had declined to 54, being small and very weak, and the temperature to 89° Fahr. Death ensued very shortly afterwards.

A calf, also bitten by a rabid dog, registered 103° Fahr. after signs of madness came on, the pulse 52 and respira-

* 'Minute Structure and Functions of the Spinal Cord and Medulla Oblongata,' 'Syd. Soc.,' p. 229.

tions 30. On the day of death the pulse was 47, respirations 15, and temperature $101^{\circ}8$ Fahr.

The temperature of a ewe and ram, which died also of hydrophobia, was 107° Fahr.

In a case of *paraplegia* in a large sporting dog—an illustration of many others—the mean temperature of nineteen observations was 101° Fahr.; the highest reading being 103° Fahr.—on the day he was first able to walk alone—and the lowest $100^{\circ}1$, which occurred three days after admission, while on the first day it was only $100^{\circ}3$ Fahr. The pulse on admission was 146, weak and small; respirations about 60, but on account of a cough, coupled with tetanic spasms that occurred when the animal was touched, these could not be ascertained with certainty. Throughout the case the record of the pulse and temperature was in the following order: when the former was 142 the thermometer registered $100^{\circ}3$ Fahr.; at another time, when the temperature was 102° Fahr., the pulse was 120; and on the same evening the pulse was 128 and temperature $101^{\circ}1$ Fahr. On the following morning the readings were: pulse 142, small and weak: temperature $101^{\circ}3$ Fahr.; and in the evening, pulse 144, temperature $101^{\circ}2$ Fahr. When the temperature was at its highest reading, viz., 103° Fahr., on the evening of the eighth day of the disease, the pulse was 146 and stronger.

Paralysis in a Goat.—A most interesting case of this nature occurred in a goat which was placed in my hands by request, for the purpose of observation. The previous history revealed but few reliable facts, but from indirect means, cross-examination, etc., and the aid of symptoms, there was no doubt the animal had suffered from impaction of the manyplies and resulting cerebral complications.

The following extract from my case-book will give a slight idea of the nature of the malady and condition of the animal: 'Pulse 128, small and feeble; respirations 50, and irregular; temp. $102^{\circ}\cdot1$ Fahr.; perfect anæsthesia of skin over back, loins, and thighs, with general surface coldness; m. membs. injected—those of the vulva and rectum particularly; constipation, no passage of fæces, tenesmus; rumen full, motions not apparent; the animal is inattentive to surrounding objects, lies at full length, and is unable to make any muscular effort. If the fore limbs are moved or pulled, tetanic spasms seize the whole of the body; mouth hot and dry, and membrane injected; eyes closed, and pupils widely dilated.'

The case continued under observation twenty-two days, during which the temperature was taken on forty-one distinct occasions at the same hour morning and evening, the mean of which was $102^{\circ}\cdot7$ Fahr. The highest reading was $103^{\circ}\cdot2$ Fahr., the lowest $100^{\circ}\cdot3$ Fahr. Muscular power and functional activity returned, and, notwithstanding this and other symptoms of apparent health being present, the temperature at the close was $102^{\circ}\cdot3$ Fahr., and continued to maintain that elevation for several days until the animal was returned to its owner. Paralysis of the off fore leg and shoulder—presumed to depend upon lesions in connection with the spinal accessory nerve—remained also, but in every other respect nothing abnormal was noticeable seven days after being discharged. At the close of another week I received her carcase for examination, when lesions in connection with the cerebro-spinal system were detected, the cause of the whole train of symptoms, and particularly the continued elevation of temperature at the late period referred to. As in the preceding nervous affection, the pulse

indicated similar uniformity with the temperature. At one time the pulse was 128, and temperature $102^{\circ}.1$; while at the close the pulse had declined to 96, when the temperature was $102^{\circ}.1$ Fahr.

Such variations I look upon as peculiar to nervous affections, and as a result of the influence of the cerebro-spinal system over the circulation and respiration.

I now pass on to notice more briefly other conditions of morbid temperature, the record and study of which will be found of vast importance to the veterinarian. I must, however, observe that much higher readings than those already given will be obtained in the cases we are about to advance. A considerable increase of temperature is a test of the intensity of febrile action. When we have definitely arrived at the safe conclusion on the subject of normal temperature, we shall find the thermometer *an indispensable aid to the diagnosis of disease in our domestic animals*; without such we must regard it as a mere toy.

The source of heat in febrile diseases appears to result from disturbances in the general vital functions. Among the conditions capable of effecting this, through the nervous system, is an accelerated metamorphosis of tissue; increased rapidity of respiration and circulation, with its frequent attendant, augmented combustion or oxidation of assimilable materials; disturbance of the functions of the skin, and, therefore, its refrigerating properties upon the body are arrested; lastly, absorption of the heat by the whole of the tissues of the body. An increase of temperature therefore is a test not only of the *amount* of fever present, but it also declares the extent of the functional disturbance which collaterally ensues. Extreme low temperatures mark the *want* of force to

create the combustive and other functional processes, instances of which are powerfully illustrated in those peculiar forms of asphyxia caused by blood poisons and narcotic poisons, and of which coma forms a common sign. One result of an elevated temperature, and, notably, at the same time that which must occasion the greatest anxiety in the treatment of disease, is the destructive effect which is produced on the system; and in this instance, as in many others, we must acknowledge the aid of true physiology, in order to comprehend the various results of diseased action frequently presented to the veterinarian.

DISEASES OF THE RESPIRATORY ORGANS.

In affections of a pyrexial character which attack these organs, an elevation of temperature is a leading sign.

In pneumonia and pleuro-pneumonia of the horse and cow it reaches 105° and even $107^{\circ}\cdot10$ Fahr., and continues till the period of death in rapid cases. A foal examined by me near Boston, Lincolnshire, in May, 1868, suffering from pneumonia, registered $105^{\circ}\cdot2$ Fahr., death ensuing within fifteen minutes.

A draught horse, affected with *hydrothorax* in the last stage, the pulse being 68, weak and fluttering, exhibited a temperature of 105° Fahr. at four p.m., and died about nine o'clock the same evening.

Bronchitis in the dog is characterized by an elevated temperature. One case in a greyhound, as an example, registered $103^{\circ}\cdot1$ Fahr., and as recovery took place gradually sank to 100° Fahr., when the animal was discharged. *Pneumonia* in the dog is attended with similar phenomena.

Influenza in the horse betrays variable indications. An active or moderately vigorous circulation is accompanied by the highest temperature, which is about 104° Fahr., but in the catarrho-bilious form—commonly known as bilious influenza, or bilious fever, the thermometer registered as low as 97° or 98° Fahr., the extremities, nose and ears, being ‘cold as clay.’

Distemper in the dog assumes similar gradations, these affections being analogues of each other. The highest temperature I have known is $104^{\circ}\cdot4$, or nearly 105° , which at the approach of death declined to 94° Fahr.

In *Phthisis pulmonalis verminalis*, or parasitic disease of the lungs of lambs and calves, the temperature rises proportionately with the disturbance. In the most acute forms the temperature of pneumonia ensues, with a sudden decline in fatal terminations. The crisis is marked in calves by 104° or 105° , and in lambs about 107° and even higher; while the decline is about 95° in the former and 98° Fahr. in the latter.

In *emphysema of the lungs in the cow* a nearly normal temperature is witnessed. Several animals that I have examined exhibited a temperature varying from 98° to 100° Fahr., preponderating towards a mean of the readings.

In *Coryza gangrenosa*, or *malignant catarrh* of cattle, an elevation of temperature, amounting to a register of 103° or 104° , takes place in the first stages, but as the blood becomes charged with impurities it declines rapidly descending to 95° Fahr. or even lower. Similar results are due also to *purpura hæmorrhagica*, and allied affections.

In *laminitis and punctures of the feet* the elevation of temperature is remarkable. In these affections it runs

as high as 104° and even 106° . In the latter 103° Fahr. is common.

Puncture of the coffin or navicular joints, open fetlock, knee and hock joints, exhibit also similar elevations of temperature.*

Injuries to the back—chiefly muscular—in hunting, two cases of which came under my notice recently, gave a reading on each occasion of 100° . One animal died suffering from subsequent paralysis and congestion of the lungs, temperature rising to 105° Fahr. before death; the other recovered, and temperature declined to $99^{\circ}50$ Fahr.

In *diabetes insipidus* the thermometer registered 100° in the horse; and in *albuminous nephritis*—Bright's disease—the temperature was 101° ; both animals recovering, it declined to $99^{\circ}50$ Fahr.

In other instances, owing to structural disease of the kidneys interfering with the elimination of urea and similar products of metamorphosis, also in liver diseases attended more or less by toxæmia, I have observed the temperature to fall considerably below 98° Fahr.

There is probably no opportunity so well calculated to test the service of the thermometer in disease, as in those conditions termed milk fever and, more vulgarly, dropping after calving. We are not wanting in evidence to show that cows at the time of calving lose the power of standing, in consequence of the system being affected in three distinct ways: first, simple adynamia, a non-febrile affection; second, metro-peritonitis, true milk or

* On the day of the death of a horse affected with punctured navicular joint, the pulse at 7.30 a.m. was 100 and temp. $104^{\circ}9$ Fahr. At 3.30 p.m. the pulse was imperceptible at the jaw, and temp. 109° Fahr., convulsions being present.

puerperal fever; and third, a blood disease known as vitular fever, and named by Professor Simonds, very correctly, parturient apoplexy.*

In simple adynamia, by which a cow may 'drop' and remain down for several days, the thermometer seldom registers throughout more than 100° or 101°, and at the most only a few tenths above the latter reading. In metro-peritonitis we not only obtain higher febrile readings, but the diurnal variations and acute nocturnal exacerbations maintain a close relationship; while in the blood disease—parturient apoplexy—the high readings are only a few tenths above the normal temperature, during nervous excitement or convulsions, with a rapid decline contemporaneous with the approach of coma. This decline is also common to the effects of narcotic poisons; and high temperature followed by an early rapid decline characterizes narcotico-acrid or cerebro-spinal poisons. In gastro-intestinal irritation, the effects of irritant or acrid poisons, the high temperature is more uniform, recovery being pre-indicated by a gradual fall.

Nocturnal Exacerbations.—The increase of febrile excitement at or towards night is faithfully demonstrated by the thermometer. The abnormal elevation of temperature which characterizes these phenomena is due to several causes apart from the disease itself. The reparative processes and other functions are generally more active at night—which is essentially the season of repair; besides, the influence of a warm, moist atmosphere, consequent on the return of other animals to the stables, or by being closed from the external air, retards the refrigeratory powers of the skin; these, with the combined

* See 'Armatage's Cattle Doctor.' London: F. Warne and Co.

effects of nervous excitement arising from diseased action, tend powerfully to increase the animal temperature.

This is fully exemplified by carefully sponging the body when the thermometer gives high readings. The skin under high fever becomes a dry *impermeable* membrane, through which exhalation takes place very imperfectly; but after moisture is applied its action is sometimes restored, and the result is a decline of temperature, with elimination of deleterious materials from the blood—all of which prove curative. This fact goes far to establish the advantages of the Roman bath in the cure of disease. In this, as in many other therapeutic endeavours, the process is imperfectly understood, carelessly conducted, and, with illiterate observers, it falls into disrepute.

An elevation of temperature takes place in female animals during the period of *æstrum*, and continues also for a considerable time after parturition. In the former it amounts to one or two degrees, but gradually declines with the lowering of nervous excitement incidental to the period. In cows that have calved upwards of four days I have found the temperature $103^{\circ}2$, particularly if they have been travelling some distance within a few hours after parturition.

I have also remarked that cows declared to be healthy, but in high condition, housed in warm, close buildings, and fed on a stimulating diet, suffer from a pyrexial state, which is evidenced by readings from 102° to 103° Fahr. In one particular case a heifer, as well as several cows, of the Durham breed, exhibited this state while being fed on a diet of chaff, meal, oil cake, etc., but after roots—particularly mangold-wurzel—were given, the temperature declined.

These observations somewhat perplexed me at the

time, and I sought for a solution of the mystery. The hour was from three to four p.m., the day being hot and sultry, and the animals were occupying close quarters in an unsuitable shed, exposed to the direct rays of the sun. I obtained the same result at the same hour on several successive days, and afterwards examined the animals about nine a.m., when the thermometer indicated a lower temperature, varying in the number from 100° to 101° Fahr. The conclusion at which I arrived was, that the afternoon reading was simply an elevation due to the combined causes of a highly heated and close atmosphere, with the diet of highly stimulating food. Here the diurnal variation, or increase of temperature, was the result of vigorous combustion, producing temporary distress by overcharging the system with nutritious principles; surely the precursor of disease in some definite form. That it was simple fever I had no doubt. The want of more precise uniformity among the number of animals, with the falling of the temperature by the following morning, induced me to regard the phenomena as exaggerated fluctuations of normal heat. Yet I could not avoid the conviction that the treatment to which the animals were being constantly subjected brought them into dangerous proximity with more serious, if not fatal, consequences. This incident forcibly shows how misleading one observation may prove, and how needful it is to institute repeated trials: certainly twice each day, morning and evening, and always at the same hour. It also affords strong testimony of the impossibility of error on the part of the instrument, which is obedient to natural laws. As already stated, a change from dry and highly stimulating food, to one of a more succulent nature, produced a total cessation of the disturbance.

These cases have been cited as typical of the phenomena observed in the respective diseases, having been selected from among many coming beneath my notice. It is earnestly hoped that others, having the opportunity, will not fail to make known the results of their experience, that by frequent comparisons even greater truthfulness may be obtained.

THE THERMOMETER AS AN AID TO PROGNOSIS.

It was at first thought by some, who had somewhat tardily yielded to conversion in the use of the thermometer in veterinary practice, that its offices ceased after pointing out an elevation of temperature. They were not prepared to admit that it was capable of speaking to us of future, as well as of present, states. By-and-by, however, slowly, yet surely, the conclusion dawned upon the mind that the diagnostic disclosures were neither less nor more than definite indications of the probable course of the disease, together with its duration and mode of termination. So long as the fluctuations of temperature, the diurnal variations, keep within certain limits, maintaining a close connection with normal readings, no danger is to be apprehended. It is when the fluctuations are erratic, irregular, and exhibit great extremes that such results are to be looked upon with concern.

This valuable property of the thermometer is perhaps seen to greatest advantage in the case of contagious maladies, as already stated. During the period of incubation, it unmistakably shows how the system is ripening for the disease. It is the only means by which we may be assured of morbid action being instituted; and only by a careful estimate of the maintenance, fluctuation, and decline of abnormal heat, are we able to judge

with accuracy of the probable termination, whether by recovery or death.

As the thermometer speaks to us of coming disease—disease not yet characterized by any other signs than an abnormal temperature—it speaks equally by anticipation of the progress of the disease and its mode of ending. This, perhaps, may be more clearly rendered by the following examples given by Professor Gamgee :*

CASE 1.			CASE 3.		
DATE.	TEMP.	PULSE.	DATE.	TEMP.	PULSE.
19th	106°	84	19th	107°	66
20th	106·2	86	20th	106·2	68
21st	106·3	88	21st	105	72
22nd	104	87	22nd	98	120
23rd	103	98	Died at night.		
Died on the night of the 23rd.					
CASE 2.			CASE 4.		
19th	105°·8	60	19th	106°·2	65
20th	105	72	20th	103	96
21st	100	Extremely frequent.	Died at night.		
Died during the night of 21st.					

These cases prove :

‘ Firstly, that the temperature is much exalted when the pulse indicates slight or no variation from the normal standard.

‘ Secondly, that there are variations in the frequency of the pulse and the temperature during the disease.

‘ Thirdly, a sudden lowering of temperature, usually, if not always, precedes death. In the cases quoted above, where the temperature last taken is marked as high as 105° and 104°, death did not take place until ten or twelve hours after the last observation.

* ‘The Cattle Plague,’ 1886, p. 43.

‘Fourthly, with the lowering of temperature before death there is a greatly increased frequency of pulse, varying from 120 beats per minute to such a rate as to render observations almost impossible.

‘When animals recover, the temperature decreases gradually till it reaches its normal standard. There is an absence of very marked and sudden change. The transition from sickness to convalescence occurs steadily and with regularity.

‘I consider it impossible to over-estimate the importance of the thermometric observations, such as those referred to; and although similar results may be obtained in the investigation of other diseases, it is evident that the thermometer affords unerring, as well as early evidence of an animal sickening, recovering, or about to die. No other indication is so unmistakable and satisfactory, and though there are other febrile diseases associated with an early elevation of temperature, it must be admitted that, taken with the history and symptoms of the case, the accuracy afforded by thermometric observations is of the highest moment. It is somewhat remarkable that the observations, now for the first time published, were not long since made and recorded abroad.’

The utility of the thermometer, as indicating the probable course of disease, is equally as valuable in diseases of a non-contagious character. When the temperature is elevated beyond 98° Fahr., we at once understand the patient is suffering from some derangement; if it rises beyond 102° Fahr., to 104° Fahr., we are assured the pyrexial phenomena are severe; that with a tendency still to rise the prognosis will be that the patient is in a state of great danger, and when 105° or 106° Fahr. is

attained we may anticipate a fatal termination. This may be decided without reference to the pulse. It is, however, safest to make collateral observations on the state of the circulation and respiration. With high temperature is associated a rapid pulse, which usually rises in frequency, becoming feeble and indistinct as fatal terminations approach. When the temperature suddenly declines with such associations the cause may be looked for in the admixture of metamorphosed tissue material with the blood.

On the other hand, high temperature, associated with rapid pulse, and continued until death, takes place in severe inflammations, the latter becoming more rapid and feeble, and, at length, indistinct, owing to implication of the lungs and arrest of action in the organs of circulation. Such associations, viz., temperature rising to 105° , or, perhaps, 107° Fahr., and the pulse numbering, it may be, during several observations, 90, 100, or 120, with indistinctness from loss of volume, betokens death in a short space of time. Other symptoms, being fully taken into account, corroborate this conclusion; but the temperature and pulse are of themselves sufficient evidence upon which safe judgment may be based.

In typhoid diseases we may safely estimate favourable terminations when the temperature never rises beyond 103° Fahr., or falls below 98° Fahr. The attack may be considered to be mild, especially if an increased temperature of the kind referred to does not take place until the usual period of crisis. The longer it is delayed, other states being equal, the greater are the prospects of recovery. High readings in the evening, as 105° Fahr., with a diminution of not more than one degree in the morning, indicate the attack to be severe, and such

states continued after the crisis betoken great danger. An increase of temperature after somewhat low readings, continued beyond the usual crisis, is indicative of internal mischief in the form of abscess in or near important organs. On the other hand, an evening temperature of 105° Fahr., falling to 104° Fahr. in the morning, and soon gradually falling day by day, indicates declining severity, and when, after some days, 101° Fahr. is registered as the highest evening temperature, the animal has entered upon the convalescent stage.

Continuous records of 104° and 105° Fahr. show the disease has not subsided. Mischief, in the shape of serious complications, may arise. In rheumatic affections a temperature of 104° Fahr. has special significance in that direction, and in pneumonia, etc., it indicates severity of attack.

By continuous daily observations with the thermometer in numerous cases, the veterinarian will discover the special manifestations or typical laws of particular forms or classes of febrile disease. Upon this information he may build his assurance of progress, the prospective recovery or death of his patient. He will also realise that under such typical laws the temperature is normal, or characteristic of the particular class, and that its stability may be regarded as the indication of the development of the particular disease. Yet such diseases, it will be observed, will exhibit an increase or decrease of the normal temperature, or that which is proper to the disease, by the operation of accidental influences. This instability is, however, but the measure of the operation of transitory causes, and remains no longer than the operation of the accidental influences lasts. Examples will be found in the numerous instances of

neglect and failure of duty on the part of those who act as nurses to our patients. Increase of temperature will result from an injudicious allowance of stimulating food, producing constipation and undue retention of urine, or unusual noise and excitement will also account for it. On the other hand, a lowering of temperature may follow a period of absolute rest and quiet, removal of constipation, local hæmorrhage, etc. But unless these alterations are solely the result of the disease process, they will probably disappear by the time the next corresponding observation is made, that is, within twenty-four hours, when the temperature returns to the standard which forms the type of the disease. The morning readings in acute febrile diseases usually denote a lower temperature than those recorded in the evening. This is not without real significance, as will presently be shown.

As the natural course in health is for the temperature to rise towards evening, so we must expect that in disease similar phenomena will be coexistent. Stability in this respect is, therefore, a favourable sign. If, on the other hand, the stability continues from evening until morning—in other words, if the morning reading shows the same elevation as that of the previous evening—we may safely infer the patient is growing worse.

It is always a good sign when the temperature falls between the evening and the morning. The inference is that the disease is declining in intensity, and therefore there is less metamorphosis, or destruction of tissue—less wear and tear, so to speak. Conversely, when the temperature rises from the evening to the morning, we judge the animal is decidedly becoming worse.

One of the most hopeful signs to be recognised in Cattle Plague, and Typhoid Fever of the pig, is when a

fall in the temperature takes place after high readings. Although the period of crisis may only recently have passed, and the violence of some of the symptoms may remain, yet it is safe to conclude that the reparative stage has commenced when the morning temperature has fallen to about 99° Fahr. in bovine animals, and to 102° Fahr., or thereabouts, in pigs. A decided evidence of convalescence is indicated by a similar fall as exhibited by the evening reading. Convalescence ends when the morbid or disease processes cease, and this point can only be fixed by precise and continuous thermometric observation. The return of normal temperature cannot take place until the disease process is at an end; when the disturbances are removed the temperature gives assurance of it by the maintenance of unchangeability throughout all the periods of day and night. This is common in all diseases of a pyrexial nature, whether contagious or not.

A fall of the temperature in eruptive diseases indicates the crisis, or maximum severity, has been reached. In mild cases the decline from high readings to normal heat will take place within twenty-four or forty-eight hours.

In tuberculous disease of the lungs the certain sign of the continued progress of the disease is the maintenance of a high temperature; and if, added to this, the morning readings continue as high as those of the evening, the termination may be speedily fatal.

We may thus summarize the foregoing observations:

An elevation of temperature is always attendant upon the disease process. Its maximum severity, or crisis, is denoted by high readings proportionate to the character of the malady, and of which it assumes a typical importance. Such records of temperature are the true in-

dications of the degree of development to which the disease process attains, and the precise point at which it subsides or terminates. This point also marks the commencement of convalescence. The removal of forces destructive to the system is the opportunity for suspended functions to return to healthy action. This is marked by the decline of heat and return to normal temperature. Careful thermometric observations, carried on continuously throughout the disease, will establish these conclusions, and enable the practitioner to judge of its character, the purity of the typical manifestations, or their complexity. Thus an opinion may be formed—prognosis—as to the probability of a favourable termination, or the reverse.

The transition from diseased states to that of defervescence takes place in two ways. It is either slow (lysis) or rapid (crisis). Convalescence is betokened by a regular and continuous defervescence, the earliest moment of its commencement being detected by the thermometer, thus obviating the need of other and less reliable investigations. On the other hand, irregular defervescence is the sure sign of more or less serious disturbance and protracted course, which demand the utmost vigilance and judicious care.

It sometimes happens that during the period of recovery the fall of temperature may be unusually large, sinking as low as 96°, or even 95° Fahr. Such abnormal decline is due to collapse during defervescence, which may be met by the administration of stimulants, as the ethers, and especially camphor, providing otherwise there are no indications of their unsuitability.

The recurrence of high temperatures during the period of convalescence the first and sure sign of relapse, or

the commencement of a new disease, such elevation preceding the special characteristics even to the extent of days. Even when the temperature is not high, but persistent, after apparent convalescence, it may be regarded as a sure sign of incomplete recovery, although no other indication is present. Every elevation of temperature should be regarded with suspicion, and met with appropriate measures. If it arises from errors of diet, etc., a speedy return to the normal range may be expected after they are removed.

Very high temperatures usually precede fatal issues, the thermometer indicating an intensity of 106° or 107° Fahr. in equine or bovine animals, while in sheep it may rise to 109° , or even 112° Fahr., and in pigs and dogs to 107° or 108° Fahr., and even after death has apparently taken place the temperature will rise one or more tenths of a degree.

The fall or moderation of temperature during the paroxysms of disease, and when the pulse is increased in frequency, is always to be regarded as a sign of speedy dissolution.

A decline of temperature below the normal state happens in rare instances. It may precede a return to normal conditions when it is characterized by short duration. It is chiefly met with in chronic wasting diseases, acute collapse, and the toxæmia of parturient fever in the cow and ewe, and typhoid diseases of other animals.

The value of the thermometer is to be learned only by frequent use and continued observation, the pulse and other symptoms being carefully noted. Taken in conjunction with these, it may be the means of clearing up otherwise doubtful points and reconciling apparent discrepancies, but its remarkable usefulness lies in its

power of accurately denoting the *approach* of those conditions which we variously term convalescence from disease, or dissolution, which ends in death; and in contagious maladies it enables the veterinarian to discover all the animals which are sickening prior to the usual development of symptoms. In these respects, the thermometer largely prognosticates the existence of abnormal states, often some time before human observation can otherwise lay hold of definite pathognomonics, or proofs of sanative processes.

When the veterinarian once acquires correct ideas of the typical form, and deviations of temperature, exhibited in the various classes of disease, he possesses a power of safe and sound judgment unequalled by, or unknown in, any other means. He is relieved from the necessity for other and less certain methods of investigation, and is enabled to act with greater precision, often anticipating the advent of disease, or averting the calamitous results of the spread of contagion. The thermometer, as some may yet suppose, is not a scientific toy, nor is its use confined to the hospital. It is essentially the companion of the practitioner; without it no observation is reliable or complete.

POST-MORTEM ELEVATION OF TEMPERATURE.

ONE of the most remarkable facts in connection with animal temperature is the considerable elevation that sometimes occurs after death. Carpenter* quotes several interesting cases in support of the phenomenon. Davy† also relates several most important observations made on the bodies of men and animals after death—the former after severe attacks of disease registering very high temperature. From the latter authority we find the following results :—

IMMEDIATELY AFTER DEATH.

Venous Blood, J. Vein ...	...	...	105°·5
Arterial do., C. Artery ...	...	...	107°
Rectum ...	...	...	105°·5
Thermometer placed under the skin. }	Met. Bone	...	97°
	Tarsal do.	...	90°
	Knee Joint	...	102°
	Head of Thigh	...	103°
	Groin ...	...	104°

* 'Principles of Human Physiology,' 6th edition, p. 430.

† *Op. cit.*, pp. 152-229.

FIFTEEN MINUTES AFTER DEATH.

Rectum	...	...	...	...	105°
Lower parts of Liver	...	...	...	...	106°
Substance of ditto	...	...	...	...	106°·5
Ditto of Lung	...	...	...	...	106°·5
Left Ventricle	...	...	...	...	107°
Right ditto	...	...	...	...	106°
Central substance of Brain	...	...	...	...	104°
Rectum	...	...	...	...	104°·5

The bodies of human subjects gave the following results :—

I. A soldier, aged 23, died from acute rheumatism and high fever in a military hospital at Valetta, and his body was inspected *three and a half hours afterwards*, when the temperature of the atmosphere was 86°. No putrefaction was present, yet the left ventricle of the heart registered 113° Fahr., and under the lobus Spigelii of the liver 112° Fahr.

II. Aged 27. Sudden death. Temperature of room 86°. Examination *six hours afterwards*. The left ventricle of the heart registered 108°, and lobus Spigelii 107°. Fifteen minutes later the substance of the right lung, gorged with extravasated blood, gave a reading of 105° Fahr.

III. Aged 25 years. A stout muscular man died suddenly after continued fever and short delirium. Examination *four and a half hours after death*. No organic disease to account for death, although chronic abnormalities were present. Heart full of blood on the right side, the left contained only a small quantity. The thermometer placed under the left side of the heart, after

the pericardium was opened, rose to 97° ; beneath the liver near the vena porta it indicated 101° Fahr.

Similar results have been also observed in patients dying from cholera and yellow fever, as well as in febrile disorders in which the temperature before death has risen considerably above the ordinary standard, and continued even after death. In connection with the lower animals such results have either attracted no attention, or records of observations are kept private, and produce no profit. However, the subject is worthy of consideration, as it opens up a means of estimating the cause of death taking place suddenly, when the animal was not examined during the existence of febrile diseases, and in those cases which have not been sufficiently noted in life.

The explanation of the occurrence of such high temperatures as those given in cases I. and II., appears to rest upon molecular activity and the movement of fluids within the body even after the more important functions, as circulation, respiration and consciousness, have ceased. Owing to the extensive metamorphosis or oxidation of tissue which takes place during violent disease, animal temperature is elevated to an abnormal degree, and as this is a chemico-vital action, we can hardly suppose it would subside with the mere cessation of respiration and functions of the heart. It is not confined to one organ or a part. The circulation, during life, has carried the oxidizable materials to every portion of the body, by which the distribution of temperature takes place. To this we may ascribe the fact that an elevation of temperature has been noticed in bodies after death. Wunderlich, in his '*Handbuch der Pathologie*,' records a case of spontaneous or rheumatic tetanus in man, in which

the maximum temperature considerably exceeded that hitherto observed under any circumstances. Twenty-four hours before death, during increased violence of the symptoms, the temperature began to rise. The pulse was 102, and the respirations were accelerated. During the night preceding death the temperature rose $3^{\circ}3$ Fahr., yet the pulse and respirations were reduced in frequency, and other symptoms suffered no increase in severity. A short time previous to death the temperature rose to $110^{\circ}75$ Fahr., the pulse being 180. At the moment of death the thermometer registered $112^{\circ}50$ Fahr., and the temperature continued to rise, being $113^{\circ}8$ Fahr. at the end of one hour. From that time a diminution slowly took place, yet, after thirteen and a half hours, the body had not fallen to the normal temperature of the living body. It is well known that after death has taken place we have evidences of vital changes in various organs and tissues of the body by the institution of phenomena characteristic of each. Thus ciliary motion and muscular action have been observed to continue for a very lengthened period. Secretion also occurs from molecular activity—urine has been passed by the ureters and perspiration by the skin; glands have poured forth their characteristic fluids, and the poison apparatus of snakes have continued their secretion long after general death has ensued, and during prolonged dissection. In nutrition the same vitality is known to be preserved; hair has been observed to grow after death, and parts previously severed have adhered on being subsequently placed in apposition. In circulation also local activity is preserved, and were it not for some such agency which governs and promotes for a period after death the phenomena illustrative of molecular vitality, we should

be at a loss to understand the origin of the first impulse in the circulation of the blood, which takes place *towards* the centre, and quite independent of any contractile power of the heart—in fact, in many instances that organ has not the power of contraction, being then only a loose aggregation of cells without semblance of the future condition.

Assuming then these conclusions are correct, the explanation of such high temperatures after death reaches us on very possible grounds. The maintenance of animal heat depends upon the molecular activity and movement of fluids, with the inevitable continuance of chemico-vital action, so long as somatic death is delayed. When the movement of the fluids ceases, the attendant phenomena are no longer possible, and the temperature declines. By the thermometer as a test of animal heat, the variations of which are in obedience to general laws, we may be enabled to account for much that now is obscure and undefined, and establish facts where signs are unintelligible.

LOCAL TEMPERATURE.

This is another department in the employment of thermometrical observations that awaits the attention of veterinarians. If parts involved in inflammation exhibit an increased heat, already alluded to at page 38, the thermometer is the only correct test of its intensity, as well as an indicator of its existence. For this purpose suitable thermometers in spiral form are prepared for application to any particular part of the body. In common practice the hand is considered to be a sufficient test. It is, however, impossible always to detect an

elevation of temperature by such means, but in the thermometer we have the means of determining the slightest elevation, which in many occult cases of lameness may prove the means of most useful and practical decisions.

Lastly, I must not omit to notice an important item in connection with the use of the thermometer. If a greater desire to render this method of inquiry more general in veterinary practice is established, the pages of continental journals will be ransacked in order to obtain current information. It will be thus evident that the readings of the various thermometers, used in different parts of the European continent, must be reduced to our own style as an indispensable proceeding, before they will bear comparison or furnish the information desired.

The thermometers in use among medical men on the Continent are the Centigrade and Reaumur; the former in France, the latter in Russia and Germany, and in England that of Fahrenheit. Readings given from these are respectively distinguished by abbreviations: thus, when the Fahrenheit thermometer has been used, the reading would have the affix *Fahr.*, or simply *F.* If the Centigrade is employed, the affix *Cent.* or *C.* would be given; and to denote the Reaumur thermometer, *Rea.*, or simply *R.*, would be added.

In each of these instruments the vernier or scale differs, which is calculated to produce considerable confusion, unless the reader is able to reduce them to an appreciable form. This is usually effected by reference to tables prepared for the purpose—one of which is given at the end; but this is not always convenient, and in that case a simple method of calculation serves all

purposes very accurately. The plan is constructed on the relative size of the space occupied on each instrument, called a degree; that of Fahrenheit being 5-9ths of the Centigrade degree, and 4-9ths of the Reaumur. To convert Centigrade readings into Fahrenheit calculation we first multiply them by 9, divide the product by 5, and add 32° to the result.

The following statement will explain how 104° Fahr. is converted into 40° Cent., and 32° Rea., and *vice versa*.

Fahr.	Fahr.	Cent.	Rea.
104°	104°	40°	32°
32	32	9	9
72	72	5)360	4)288
5	4	72	72
9)360	9)288	32	32
40° Cent.	32° Rea.	104° Fahr.	104° Fahr.

The employment of the thermometer as an aid to the diagnosis of disease promises well, and there is little doubt at some future day, when its application and warnings are more perfectly understood, many welcome rays of light will beam upon us that are now almost undreamed of, and upon which our speculation is at the best very vague indeed. There is every probability also that our acquaintance with the laws of the animal economy must be increased by its constant employment; and the collateral influences of air and winds, warm or cold moist atmospheres, whether arising in the ordinary course of nature's operations, or as the result of the arrangement of buildings, inefficient ventilation, etc., will

receive greater attention as causes of disease, while more scientific methods will be suggested for their amelioration or removal. Much of this is spoken of by the thermometer, but we are yet too dull to decipher its warnings.

Table showing the equivalents of temperature registered by the Centigrade, Fahrenheit, and Reaumur Thermometers.

CENT.	FAHR.	REA.	CENT.	FAHR.	REA.
50°	122·0°	40·0°	31°	87·8°	24·8°
49	120·2	39·2	30	86·0	24·0
48	118·4	38·4	29	84·2	23·2
47	116·6	37·6	28	82·4	22·4
46	114·8	36·8	27	80·6	21·6
45	113·0	36·0	26	78·8	20·8
44	111·2	35·2	25	77·0	20·0
43	109·4	34·4	24	75·2	19·2
42	107·6	33·6	23	73·4	18·4
41	105·8	32·8	22	71·6	17·6
40	104·0	32·0	21	69·8	16·8
39	102·2	31·2	20	68·0	16·0
38	100·4	30·4	19	66·2	15·2
37	98·6	29·6	18	64·4	14·4
36	96·8	28·8	17	62·6	13·6
35	95·0	28·0	16	60·8	12·8
34	93·2	27·2			
33	91·4	26·4			
32	89·6	25·6			

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THE END.

